

Recent Advances in Time-Frequency Analysis for Fault Detection and Diagnosis of Complex Industrial Processes

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Abstract

Complex industrial processes play a vital role in modern industry, where process monitoring and fault diagnosis are essential for ensuring safety, efficiency, and product quality. However, industrial process data are often nonlinear, nonstationary, and strongly coupled, making conventional monitoring methods difficult to apply effectively. Time-frequency analysis provides an effective tool for revealing dynamic process behaviors and extracting fault-related information from complex industrial data. This lecture will present recent advances in time-frequency analysis for industrial process monitoring, including signal decomposition, time-frequency representation, and feature extraction techniques for oscillatory fault detection and diagnosis. Representative applications from phosphate chemical plants in Yunnan Province will be introduced, covering process feature extraction, quality monitoring, plant-wide fault detection, root-cause analysis, and fault diagnosis. These studies demonstrate the potential of time-frequency analysis in supporting intelligent monitoring and operation of complex industrial processes.



Jiande Wu received the B.S. and M.S. degrees in Automation and Mechatronic Engineering from Northwestern Polytechnical University, Xi'an, China, in 2001 and 2004, respectively, and the Ph.D. degree in Automation from Zhejiang University, Hangzhou, China, in 2007. He is currently a Professor at Yunnan University and has been recognized as a National High-Level Leading Talent and a Yunling Scholar. He also serves as the Director of the Engineering Technology Research Center for Intelligent Systems and Advanced Control of the Nonferrous Metals

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His research interests focus on fault detection and intelligent control of complex industrial processes, as well as industrial big data analysis and modeling. He has presided over more than 20 research projects, including key projects of the National Natural Science Foundation of China (Regional Joint Fund) and major science and technology projects of Yunnan Province. He has published over 70 papers in prestigious journals such as IEEE Transactions and holds more than 40 authorized patents. His research achievements have received several major awards, including the Second Prize of the National Science and Technology Progress Award, the First Prize of the Yunnan Provincial Science and Technology Progress Award, the First Prize of the Yunnan Provincial Natural Science Award, and the First Prize of the Natural Science Award of the Chinese Association of Automation.